

METHOD FOR WRAPPING RUBBER STRIP AND WRAPPING APPARATUS

Background of the Invention:

The invention relates to a method for wrapping rubber strip around a forming drum in manufacture of a pneumatic tire and a wrapping apparatus, and more particularly to a method for wrapping rubber strip and a wrapping apparatus in which an accuracy of wrapping of the rubber strip is improved.

As a method for manufacturing the pneumatic tire, a process including steps of supplying an unvulcanized rubber strip from an injection device continuously, wrapping the rubber strip around the forming drum and forming tire-constituting members such as a cap tread, an under tread, a side tread and a rim cushion rubber part based on a laminated structure of the rubber strip has been performed.

There have been advantages by forming the tire-constituting members directly in such manner as described above that a manufacturing efficiency of the tire can be improved, as well as saving in space can be realized since the tire-constituting members formed in advance should not be stored, as a result, a manufacturing cost of the tire can be reduced.

However, it has been extremely difficult to wrap around the forming drum with the high accuracy since the rubber strip in an initial stage extruded from the injection device tends to result in overshoot to show unstable output. In such manner as described above, when the accuracy in wrapping the rubber strip is inferior, quality of the pneumatic tire becomes unstable.

Summary of the Invention:

The object of the invention is to provide a method for wrapping rubber strip and a wrapping device in which variation in an amount of extrusion of the rubber strip is absorbed between the injection device and

the forming drum, whereby the rubber strip can be wrapped with the high accuracy.

A method for wrapping rubber strip according to the invention for accomplishing the object described above is a method for wrapping a rubber strip around a forming drum while extruding an unvulcanized rubber strip  
5 from an injection device, comprising steps of :

pressing the rubber strip by a guide roll against the forming drum under tension while forming a space for absorbing variations in an amount of extrusion of the rubber strip between said guide roll and an extrusion  
10 outlet of the injection device;

rotating the forming drum in synchronism with extrusion of the rubber strip so that the guide roll is driven; and

wrapping the rubber strip guided by the guide roll around the forming drum.

15 In such manner as described above, since the rubber strip is pressed by the guide roll against the forming drum under tension while the space is formed for absorbing variations in the amount of extrusion of the rubber strip between said guide roll and the extrusion outlet of said injection device, even though the amount of extrusion of the rubber strip is unstable  
20 at an initial stage of extrusion or the like, variations in the amount of extrusion can be absorbed in the space. Therefore, the rubber strip guided by the guide roll can be wrapped around the forming drum with the high accuracy. Moreover, an excellent guiding function can be shown and the accuracy of wrapping further can be improved, when an angle of contact  
25 between the guide roll and the rubber strip is sufficiently enlarged.

On the other hand, a device for wrapping rubber strip according to the invention for accomplishing the object described above is a device

for wrapping rubber strip around a forming drum while extruding an  
 5 unvulcanized rubber strip from an injection device, comprising a guide roll  
 arranged between the injection device and the forming drum through a freely  
 stretchable and contractible arm member along a supplying channel for the  
 rubber strip, wherein the rubber strip is pressed by the guide roll against  
 the forming drum under tension when the arm is stretched, as well as a space  
 for absorbing variations in an amount of extrusion of the rubber strip is  
 formed between the guide roll and an extrusion outlet of the injection  
 device.

10 In the invention, it is preferable that the guide roll is released  
 from the forming drum at a final stage of wrapping of the rubber strip to  
 form a clearance between the forming drum and the guide roll, and the rubber  
 strip is cut off within the clearance. The rubber strip is cut off within  
 the clearance as described above, whereby a subsequent wrapping operation  
 15 can be performed successively, since the cut end of the rubber strip still  
 remains on the guide roll. Moreover, tension is applied to the rubber  
 strip from an initial stage of wrapping at the subsequent wrapping  
 operation, whereby the rubber strip can be wrapped with the high accuracy.  
 As a device in this case, a cutting device which cuts off the rubber strip  
 20 within a clearance can be provided, the clearance being arranged between  
 the forming drum and the guide roll when the arm member is contracted.

Moreover, a press roll for pressing the cut end of the rubber strip  
 against the forming drum can be provided at the vicinity of the guide roll  
 when the cut end is pressed against the forming drum by the press roll,  
 25 disarrangement of the cut end of the rubber strip is prevented.

#### Brief Description of the Drawings:

Fig. 1 is an enlarged front elevation showing component parts of

a device for wrapping rubber strip according to an embodiment of the invention.

Fig. 2 is a side elevation showing the device (at wrapping) for wrapping rubber strip according to the embodiment of the invention.

5 Fig. 3 is a side elevation showing the device (at cutting off) for wrapping rubber strip according to the embodiment of the invention.

#### Detailed Description of the Preferred Embodiments:

Hereinafter, the invention will be described with reference to drawings.

10 Fig. 1 to Fig. 3 show the devices for wrapping rubber strip according to the embodiment of the invention. The wrapping device according to this embodiment is constituted in such manner that an injection device 1 is arranged so as to oppose to an outer peripheral surface of a forming drum D, and this injection device 1 is reciprocated  
15 in the axial direction of the forming drum D. A quantitative extruder of a plunger type, which is not limited thereto in particular, may preferably be used in order to extrude the tire-constituting members of one tire precisely and quantitatively for an extruding mechanism of the injection device 1.

20 The injection device 1 is designed to comprise the extrusion outlet 3 at a front plate 2 to extrude a rubber strip S from the extrusion outlet 3 continuously. A pair of arm members 4 and 4 of the left and right are arranged on the front plate 2 in the horizontal direction toward the forming drum D. The arm member 4 comprises a fixed section 4a attached to the front  
25 plate 2 and a moving section 4b freely stretchable and contractible from the fixed section 4a along the supplying channel for the rubber strip S, and is designed to produce the stretching or contracting motion by an air

cylinder or the like.

A bracket 5 is attached to the side of the moving section 4b of each arm member 4. Moreover, a guide roll 7 is born through a bearing member 6 attached across a pair of brackets 5 and 5 of the left and right on the tip side of the arm member 4. Engagement members 7a are attached to both ends of this guide roll 7. Moreover, the guide roll 7 is driven by the forming drum D to revolve in one direction, but revolution of the reverse direction is restrained. Therefore, the guide roll 7 can apply tension to the rubber strip S supplied from the injection device 1.

As shown in Fig. 2, the rubber strip S is pressed against the forming drum D under tension by the guide roll 7 when the arm member 4 is stretched, as well as a space for absorbing variations in the amount of extrusion of the rubber strip S between the guide roll 7 and the extrusion outlet 3 of the injection device. A length of the space is preferably formed into 100mm to 200mm in order to absorb overshoot in the initial stage. On the other hand, a clearance is formed between the forming drum D and the guide roll 7 when the arm member 4 is contracted as shown in Fig. 3.

The cutting device 8 for cutting off the rubber strip S between the forming drum D and the guide roll 7 is arranged on the tip portion of the arm member 4. Namely, a bracket 9 is attached to the end of the moving section 4b of each arm member 4, and a rotary actuator 10 is installed on this bracket 9. A rotary shaft 10a of the rotary actuator 10 is coupled with a swiveling shaft 12a of a swiveling wing 12 through a coupling 11. This swiveling shaft 12a is born by a bearing 13. A bracket 14 is coupled with the swiveling wing 12. Moreover, a wire 15 providing a cutter is tensioned and arranged across a pair of brackets 14 and 14 of the left and right.

The described-above cutting device 8 is designed to rotate the wire 15 along a track X shown by a dashed line shown in Fig. 3 by driving of the rotary actuator 10, thereby to cut off the rubber strip S between the forming drum D and the guide roll 7.

5 On the lower side of the guide roll 7, a cylinder 16 having a freely stretchable and contractible rod 16a is attached to the front plate 2 through a bracket 17. A press roll 19 is born through a bearing member 18 on the tip portion of this rod 16a. Engagement members 19a are attached to both ends of the rotary shaft of the press roll 19. This press roll 10 19 pressurizes the rubber strip S against the forming drum D at all time.

Next, an operation of the device for wrapping rubber strip will be described. First, the rubber strip S is extruded from the extrusion outlet 3 of the injection device 1 at a predetermined length and the tip portion thereof is set on the guide roll 7. At this point of time, the 15 rubber strip S is provided with a length capable of pasting to the forming drum D.

Next, the rubber strip S is pressed by the guide roll 7 against the forming drum D under tension by turning the arm member 4 into the stretched condition, as well as the space for absorbing variations in the 20 amount of extrusion of the rubber strip S is formed between the guide roll 7 and the extrusion outlet 3 of the injection device 1 as shown in Fig. 2. Subsequently, the guide roll 7 which comes in contact with the forming drum D through the rubber strip S is driven by rotating the forming drum D, synchronizing with extrusion of the rubber strip S. According to this 25 operation, the rubber strip S guided by the guide roll 7 is wrapped around the outer peripheral surface of the forming drum.

As is mentioned above, the rubber strip S is pressed against the

forming drum D under tension by the guide roll 7 and the space for absorbing variations in the amount of extrusion of the rubber strip S is formed between the guide roll 7 and the extrusion outlet 3 of the injection device 1, whereby the variations can be absorbed in the space between the guide  
 5 roll 7 and the extrusion outlet 3, even though the rubber strip S shows unstable output. Namely, since tension is applied to the rubber strip S, the rubber strip S can not be bent or wavy even though overshoot is occurred. Therefore, in a strip-winding forming method using the injection device 1, the rubber strip can be wrapped with the high accuracy.

10 As shown in Fig. 3, the arm member 4 is turned into a contracted condition right before the end of the wrapping, whereby the guide roll 7 is released from the forming drum D and the clearance is formed between the forming drum D and the guide roll 7. Subsequently, the rubber strip S is cut off between the forming drum D and the guide roll 7 by rotating  
 15 the wire 15 of the cutting device 8.

As is mentioned above, the rubber strip S is cut off within the clearance between the forming drum D and the guide roll 7, whereby the cut end of the rubber strip S still remains on the guide roll 7. Consequently, the rubber strip S is not required to introduce on the guide roll 7 by manual  
 20 work when initiating the subsequent wrapping operation, whereby a plurality of wrapping operations can be performed successively. Moreover, since the guide roll 7 is moved toward the side of the forming drum D at the subsequent wrapping operation, thereby tension being applied to the rubber strip S from an initial stage of wrapping, the rubber strip S can  
 25 be wrapped with the high accuracy.

Moreover, the cut end is pressed against the forming drum D by the press roll 19 when the rubber strip S is cut off, whereby the cut end of

the rubber strip S can be prevented from disarranging and the accuracy of wrapping further can be improved.

In the invention, the number of wrapping of the rubber strip S against the forming drum D and the amount of movement of the rubber strip S in the axial direction of the forming drum D are controlled, whereby the tire-constituting members having the desired cross section can be formed on the outer peripheral side of the forming drum D, therefore, these tire-constituting members can be formed with the high accuracy. A cap tread, an under tread, a side tread and a rim cushion rubber part or the like for pneumatic tire can be listed as the described-above tire-constituting members.

According to the invention as described above, the rubber strip is pressed against the forming drum under tension by the guide roll, as well as the space for absorbing variations in the amount of extrusion of the rubber strip is formed between the guide roll and the extrusion outlet of the injection device, the forming drum is rotated in synchronism with extrusion of the rubber strip so that the guide roll is driven, and the rubber strip guided by the guide roll is wrapped around the forming drum, whereby the variations can be absorbed in the space, even though the amount of extrusion of the rubber strip is not stabilized at the initial stage of extrusion or the like, therefore, the rubber strip can be wrapped with the high accuracy.